



# An Investigation into Sea Depth Measurement

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## Abstract

The sea covers 71% of the Earth's surface 95% of which is unexplored [1]. Monitoring the properties of the ocean has both environmental and commercial applications. Four depth measurement technologies were researched, after this research one method was chosen for further investigation. Echo sounders were chosen and a device was developed using the spiral method, with the aim of making depth measurements using this technology. By the final prototype the device could make surface level measurements and in air distance measurements but was not capable of submerged measurements.

## Aim of Project

The aim of this project is to investigate sea depth measurement techniques and analyze the concepts and issues involved with these measurements then develop a system capable of making depth measurements to further explore the subject area.

## Current Methods

### Satellite

This method uses satellites currently in orbit to monitor several aspects of the ocean such as depth and temperature. This is good for mapping large areas but due to the nature of the technology it is inaccurate [2]

### Automated underwater vehicles (AUV)

These are small vehicles are typically deployed from larger vessels that follow a set path along the sea floor mapping depth using sonar. These devices are much more accurate as they are a lot closer to the object being measured however are slow to map large areas. [3]

### Restricted floating sensors

These sensors are typically used to map a small area such as a harbour. They operate by using a floating object that is tethered to the sea floor, this then uses the length of the tether and the drift of the float to determine currents and depth[4].

## Echo sounders and waves

### Sonar

This technology uses the emission and reflection of high frequency sound waves to detect the proximity of an object as shown in figure 1 [5]. It was selected to develop this device due to the other technologies researched being too complex to implement and test within the timeframe.

### Ultrasonic wave properties

An ultrasonic wave is a longitudinal wave (figure 3 [6]) outside the range of human hearing (20kHz-10MHz). The speed of sound is greatly increased in water compared to air (340m/s in air to around 1450m/s in water). Waves of lower frequency can penetrate further into a medium but have a lower measurement resolution compared to higher frequencies [6].

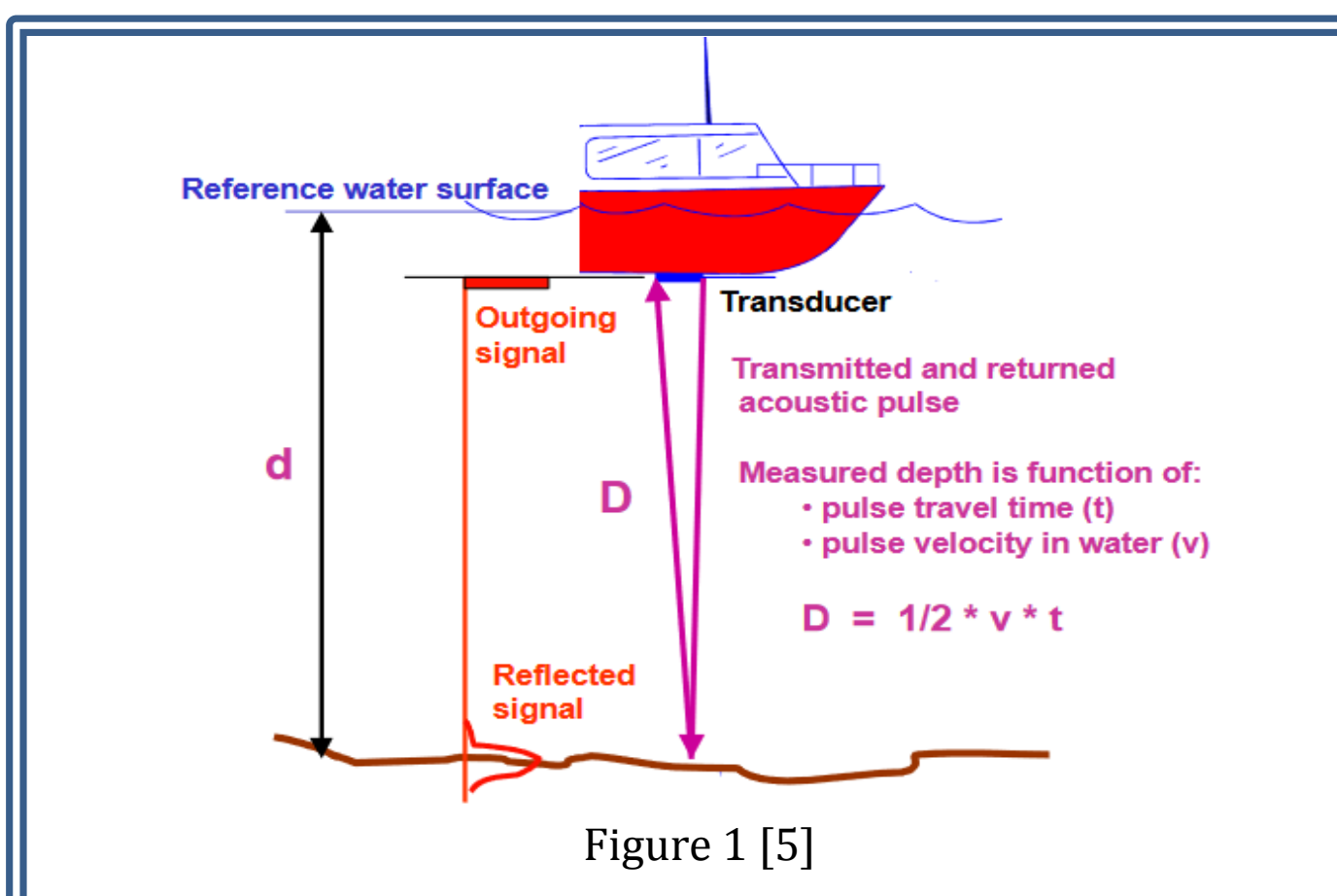


Figure 1 [5]

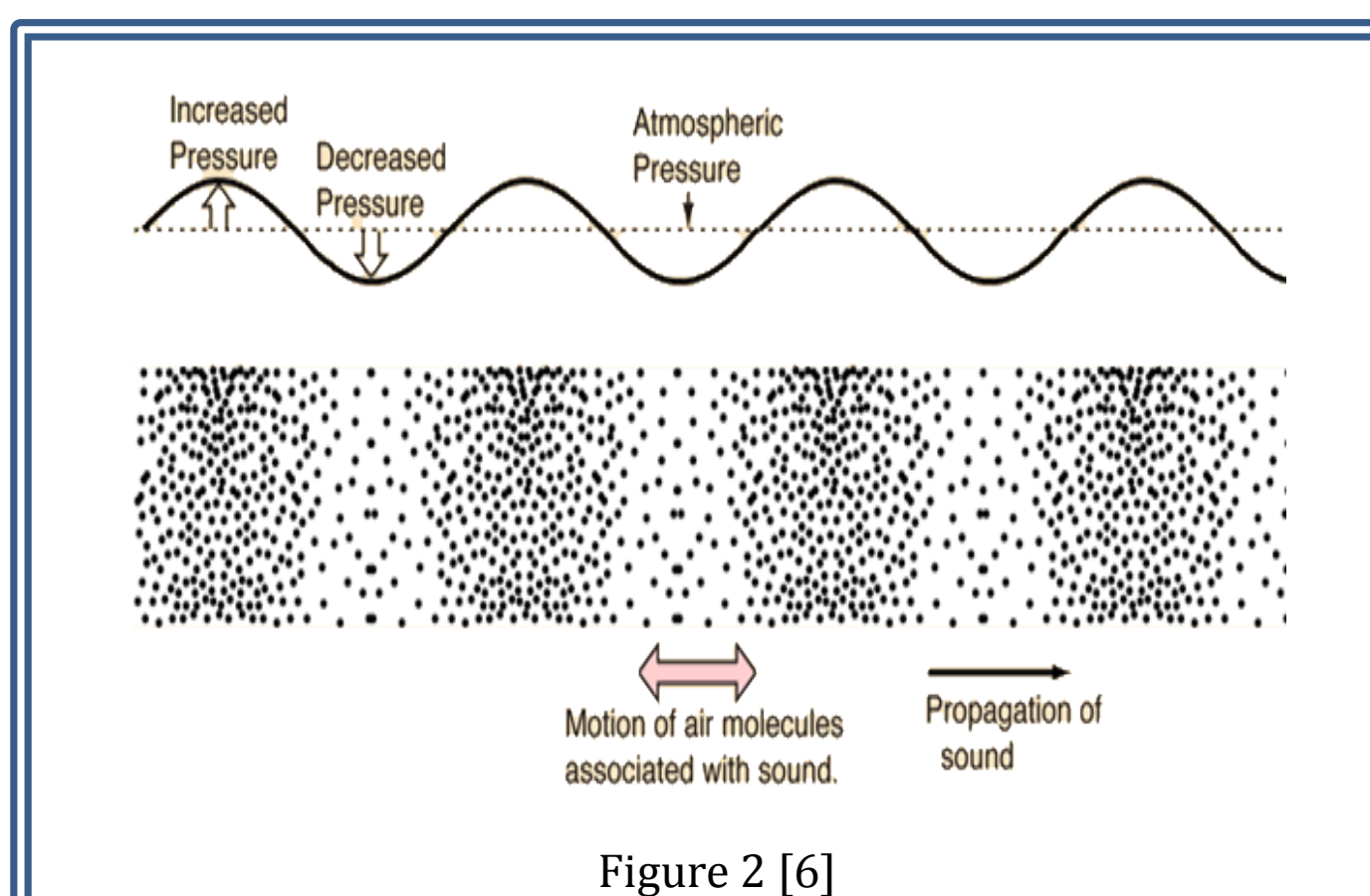


Figure 2 [6]

## Prototypes

### First prototype

Used HC-SR04 (Figure 3) sensor to successfully obtain accurate distance measurements in air.

### Second prototype

Swapped transducers of HC-SR04 (figure 4) with waterproof transducers. With poor results.

### Third prototype

Used JSN-SR04 2.0 (figure 5) chip obtained inconsistent measurements in air but could not obtain measurements submerged in water.

### Fourth prototype

Used JSN-SR04 chip obtained consistent measurements in air but could not obtain measurements submerged in water.

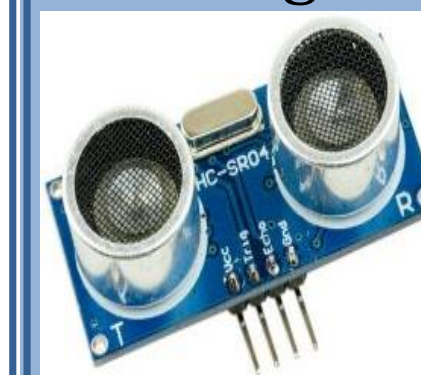


Figure 3

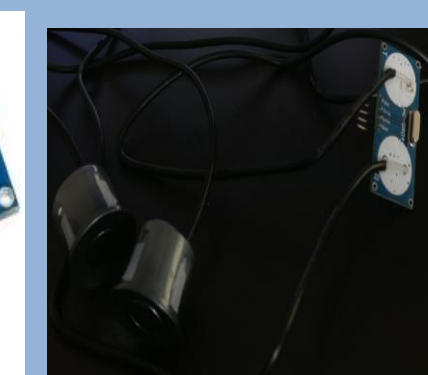


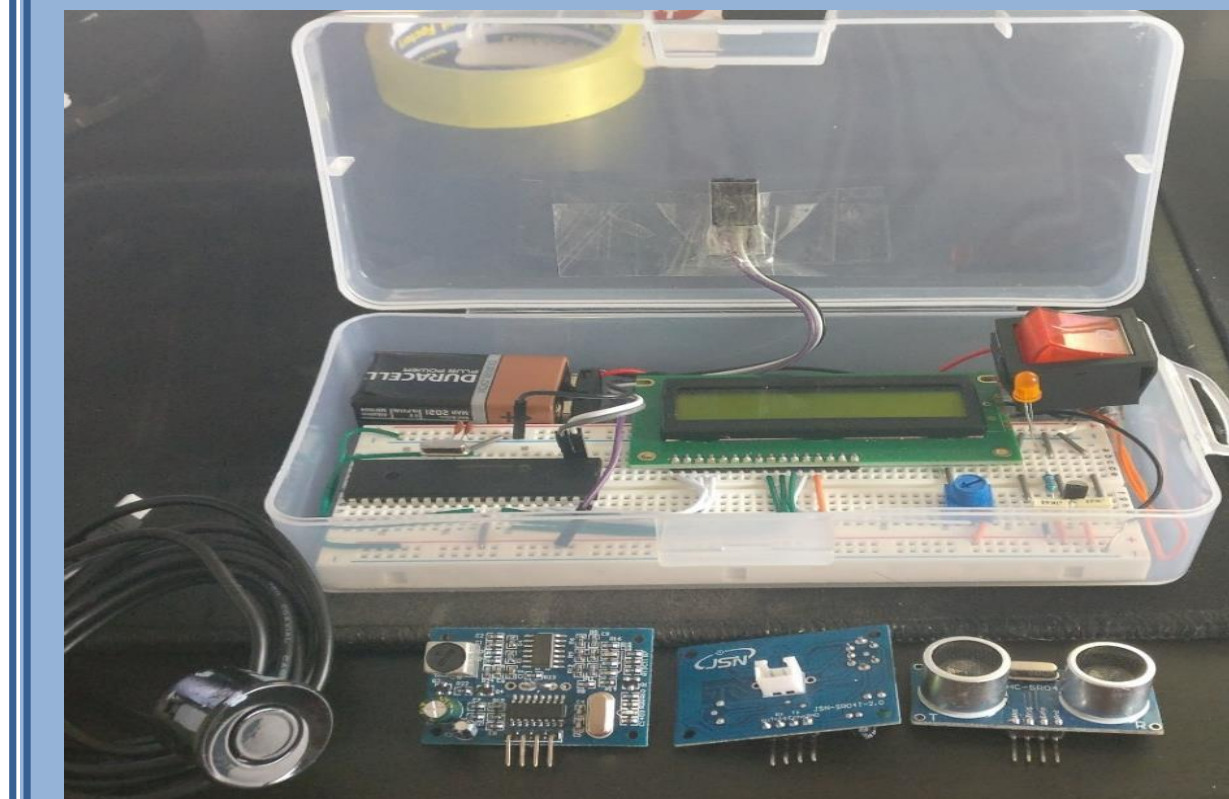
Figure 4



Figure 5

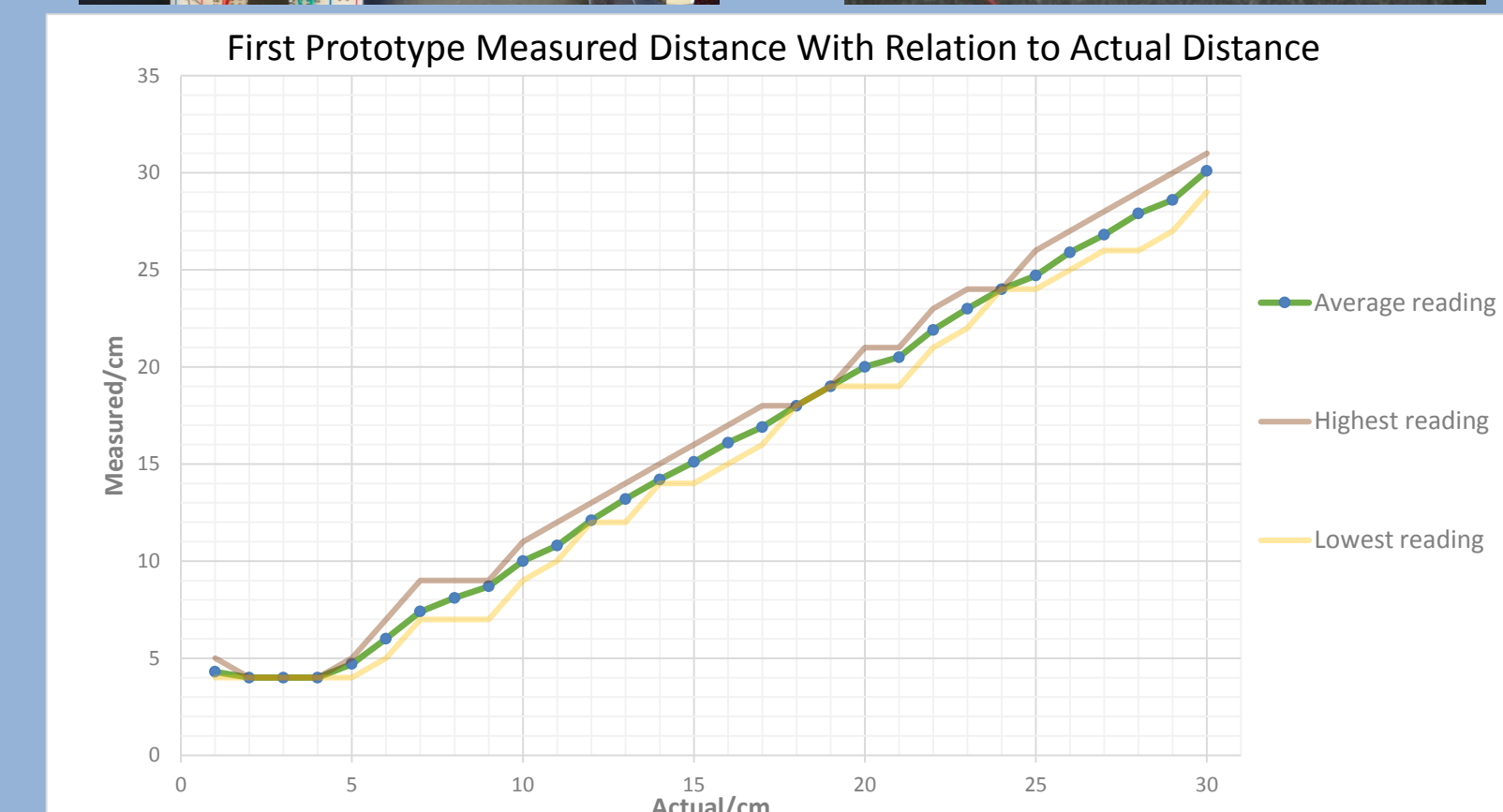
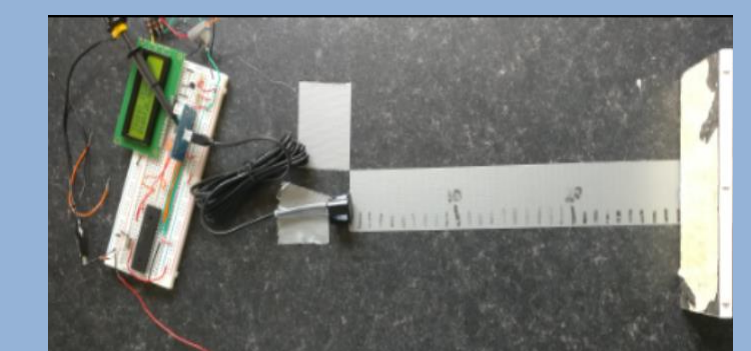
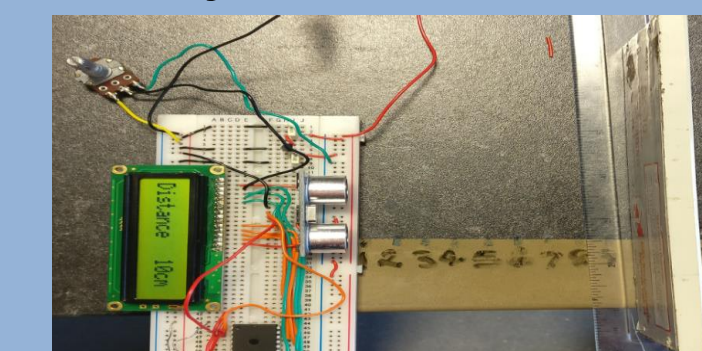
## Final prototype

Final prototype was capable of making surface level measurements, within 1cm of accuracy up to around 80cm and had a maximum range of around 500cm. Displays pulse width from sensor and distance measured.



## Testing and Results

Testing of each prototype was done by placing an object at varying distances to test the systems accuracy.



## Conclusions

The transducers used although waterproof were not powerful enough to transmit and receive ultrasonic signals when submerged.

In theory if a powerful enough transducer was used a simple calculation change would give distance in water.

Time of flight measurement and the angle of the reflector are both very important to the accuracy of the distance measurement.

## References

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